

# STATUS OF RRTMG IN WACCM

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# RADIATION MIGRATION

CAMRT->RRTMG

(1000 -> .01 HPA)

- What changed and why it is changing
- Merging WACCM (Non-LTE) Radiation with LTE Radiation
  - Differences between Non-LTE, RRTMG, CAMRT
- Simulation differences CAMRT vs RRTMG

WHAT IS CHANGING?

WHY?

# RADIATION (UP TO $\sim 75\text{KM}$ )

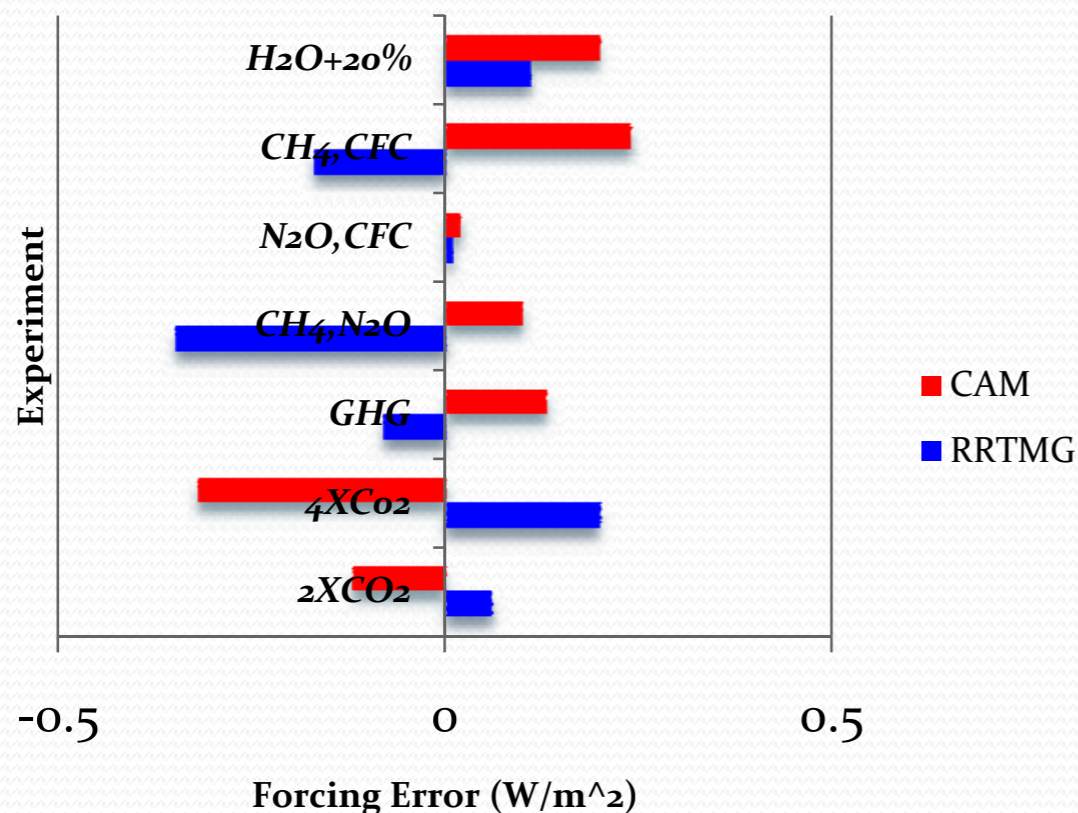
- Optics for Gases (RRTMG from AER)
- New Frequency Bands (Easier interface to IR Bands)
- RT Solver for SW and LW (RRTMG)
- Cloud Overlap (McICA) (RRTMG)
- New Solar: Solar Const(t)  $\rightarrow$  SSI(t)

# WHAT DIDN'T CHANGE?

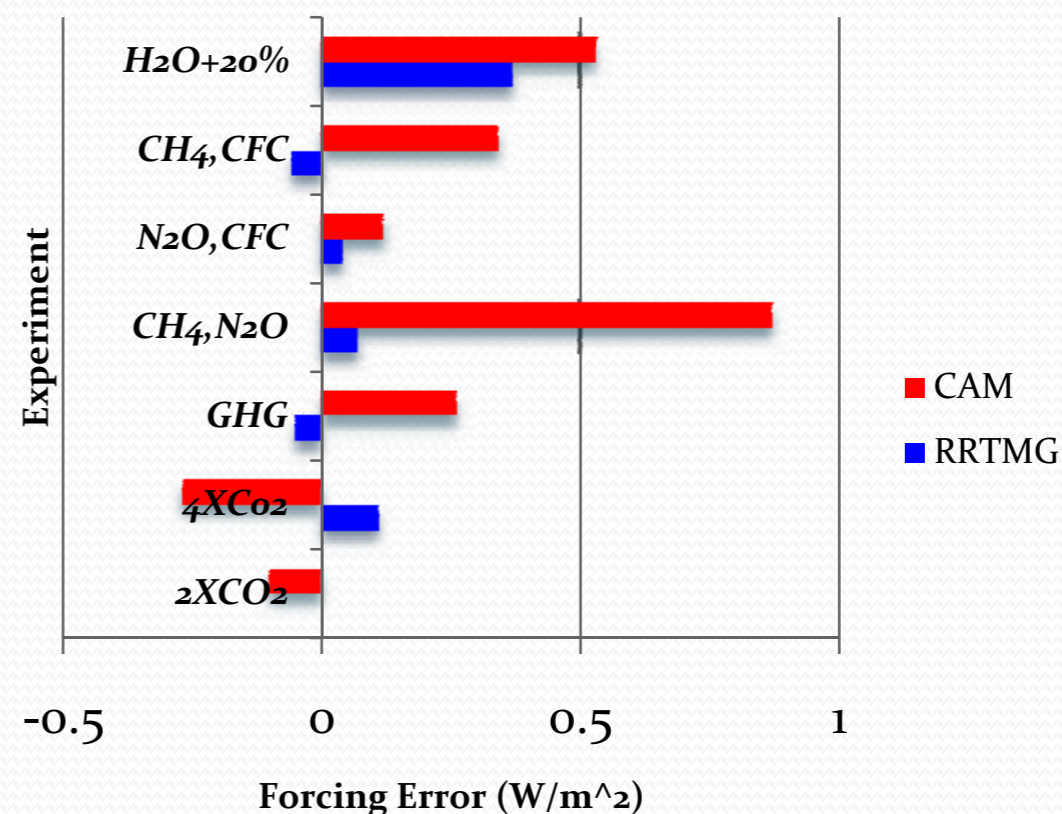
- 2-stream solver for shortwave
- Flux-based integration in longwave (no scattering)
- 4 parameters for surface SW albedo
- Tropospheric aerosol optics are similar

# Climate Forcing Accuracy (RTMIP)\*

## LW Forcing Error: 200 hPa



## LW Forcing Error: Surface



LW Benchmark code is LBLRTM.

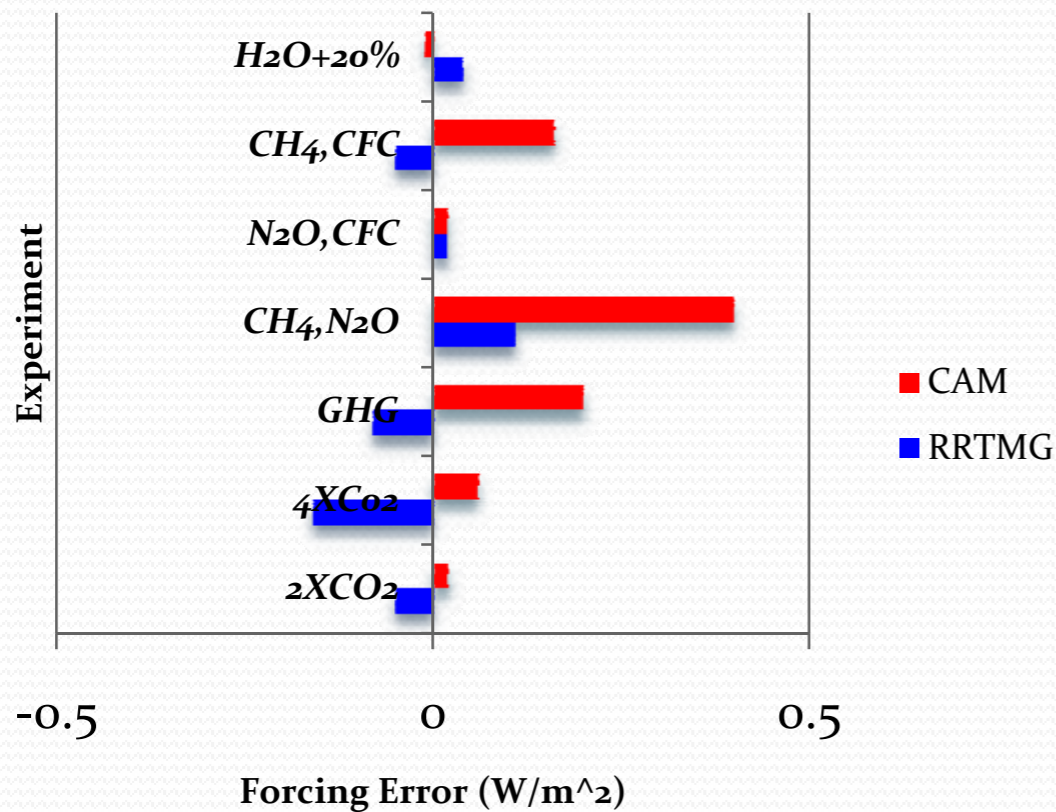
Experiments:

- GHG :: 1860->2000 (all species)
- CH<sub>4</sub>,N<sub>2</sub>O :: 0 ppm -> 2000
- N<sub>2</sub>O, CFC :: 1860 -> 2000
- CH<sub>4</sub>,CFC :: 1860 -> 2000

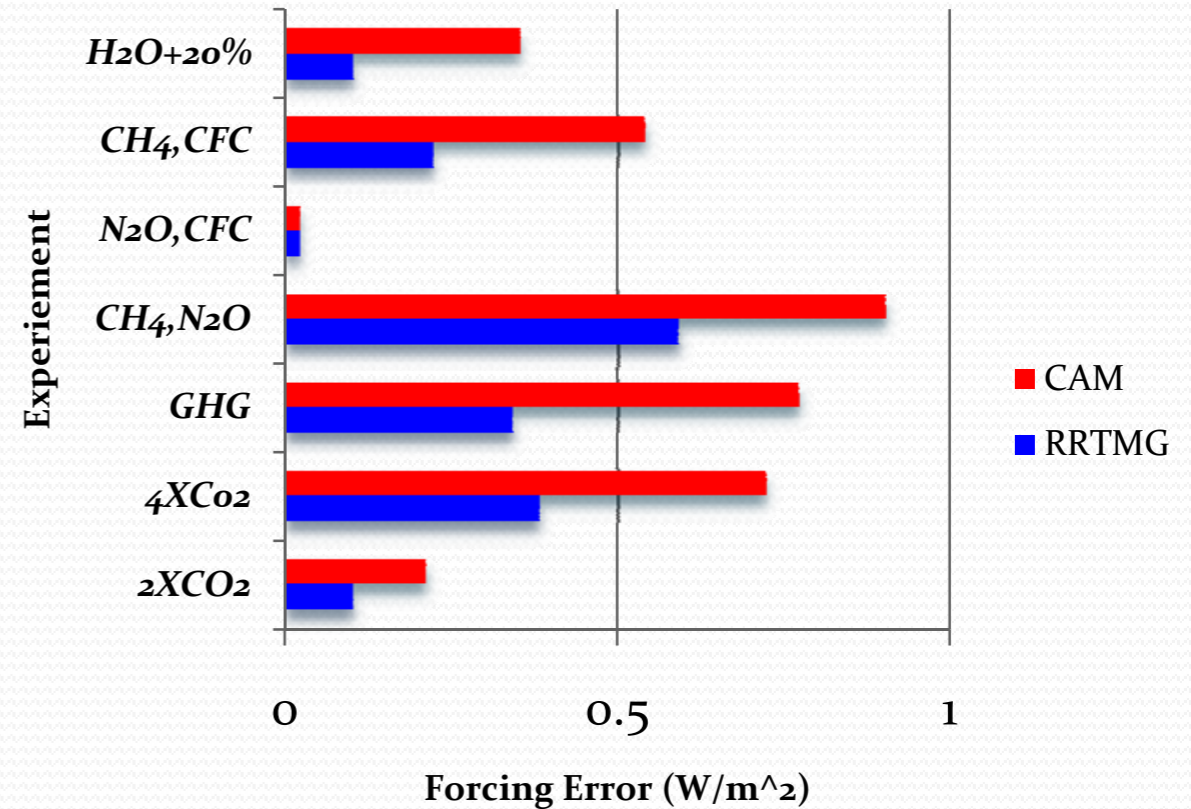
\*Collins et al, 2006; Iacono et al 2008

# Climate Forcing Accuracy (RTMIP)\*

## SW Forcing Error: 200 hPa



## SW Forcing Error: Surface



SW Benchmark code is CHARTS.

Experiments:

- GHG :: 1860->2000 (all species)
- CH<sub>4</sub>,N<sub>2</sub>O :: 0 ppm -> 2000
- N<sub>2</sub>O, CFC :: 1860 -> 2000
- CH<sub>4</sub>,CFC :: 1860 -> 2000

\*Collins et al, 2006; Iacono et al 2008

MERGING LOW AND HIGH RT

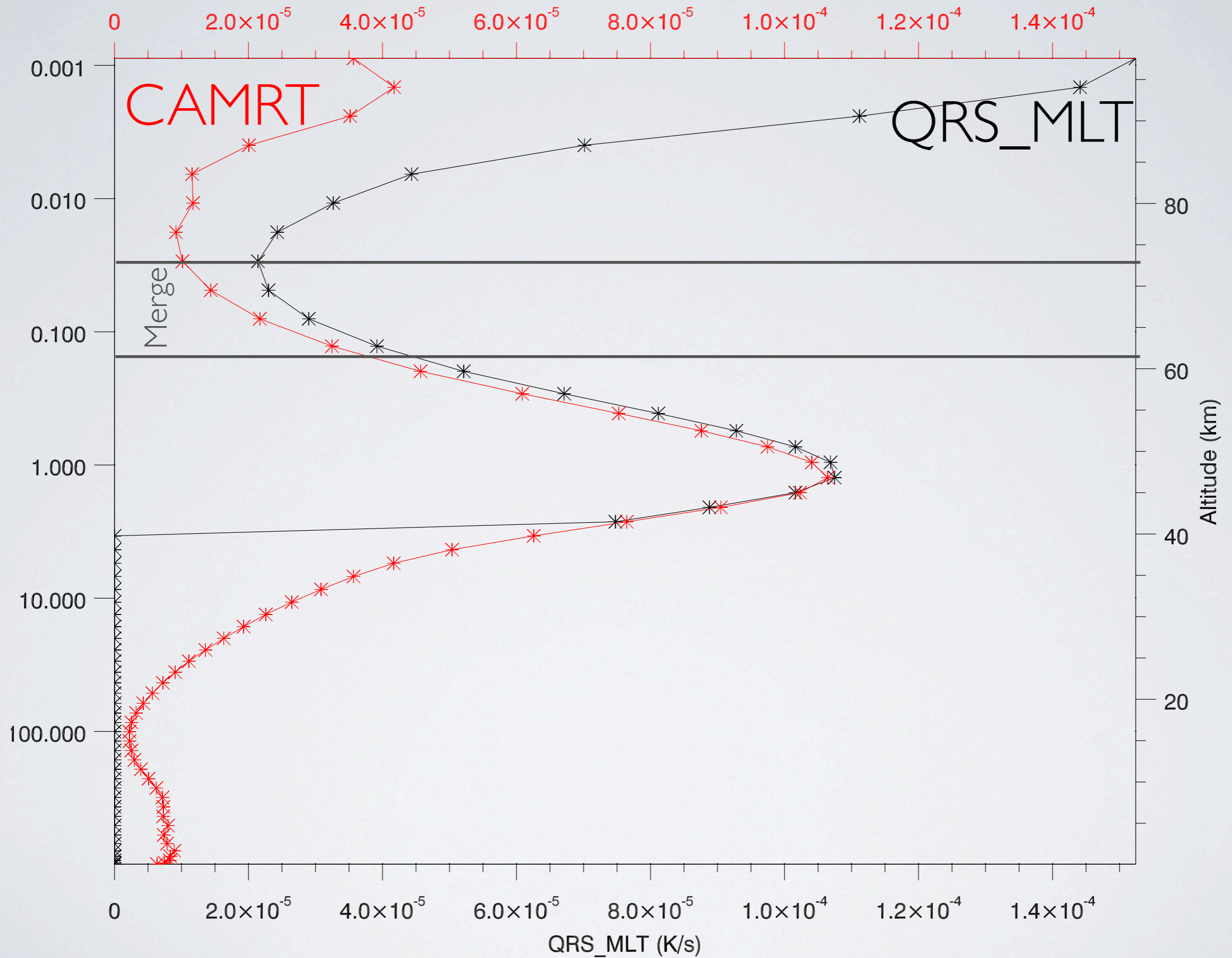
COMPARE HEATING RATES



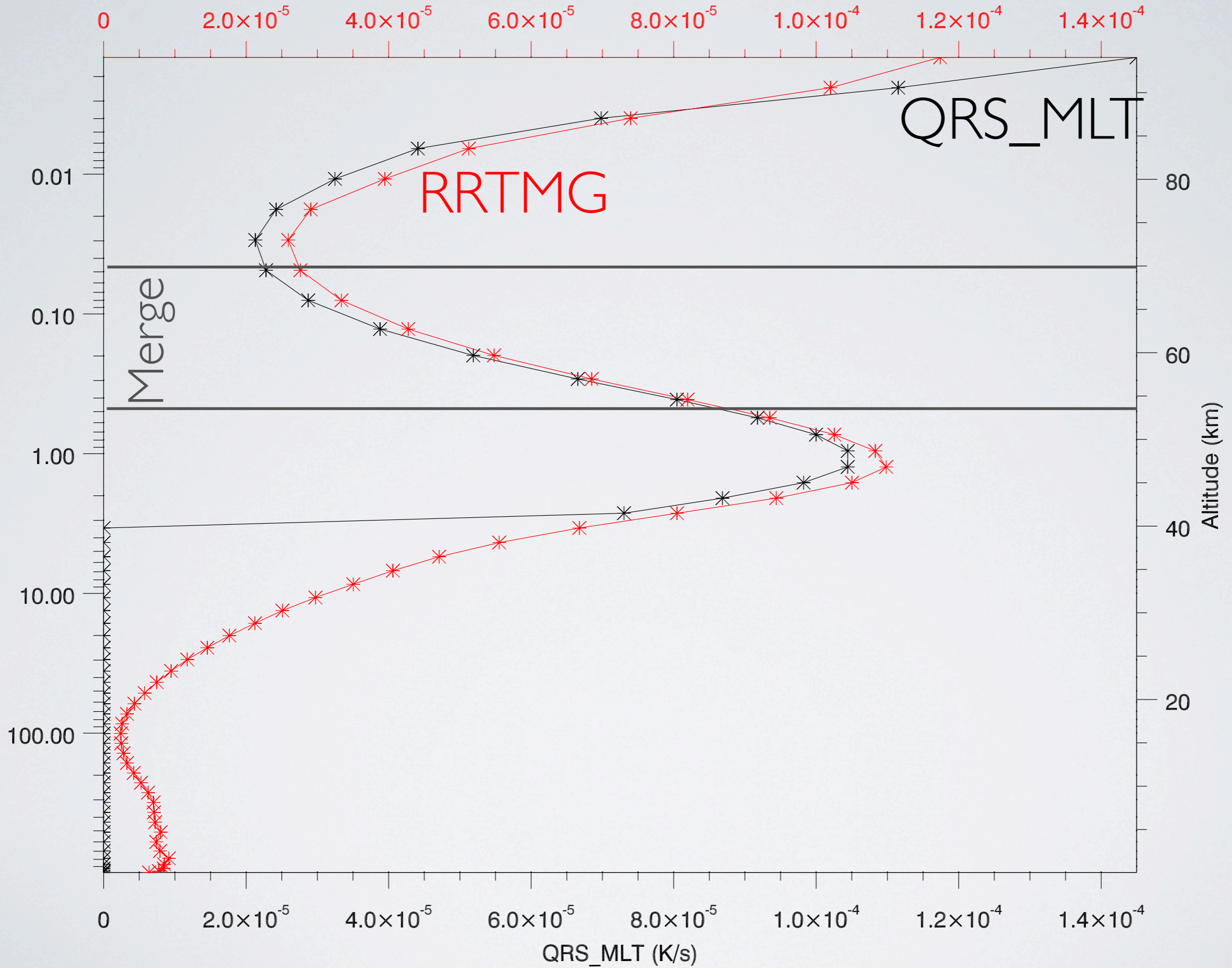
# HEATING RATES -- WACCM4

- Run WACCM4 with RRTMG and CAMRT
- Dies in month 22 due to NAT iterative solver: CWP?
- Compare
  - Non-LTE parameterizations (WACCM)
  - RRTMG
  - CAMRT

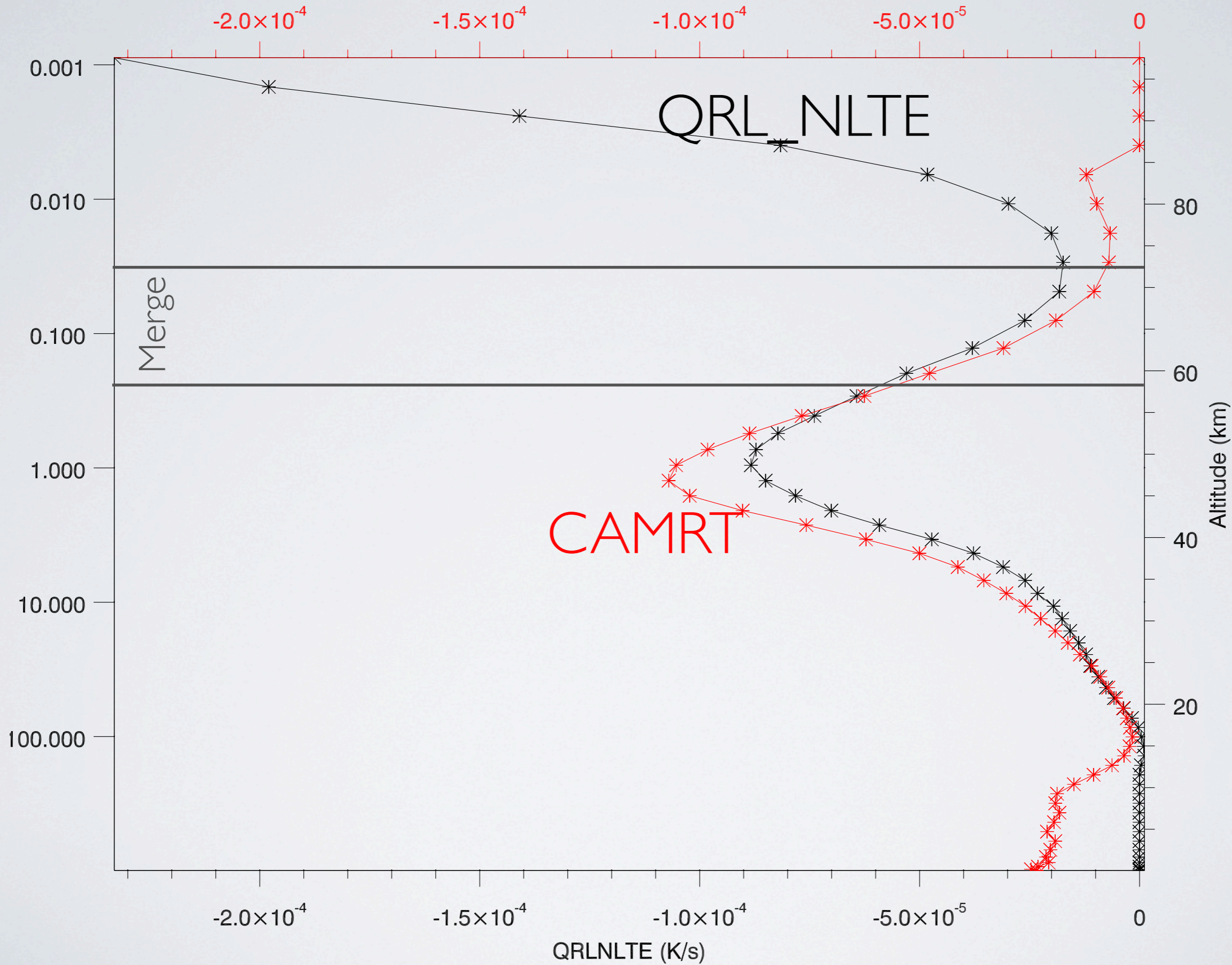
QRS\_MLT [K/s], 01Oct2002 00:00, global average



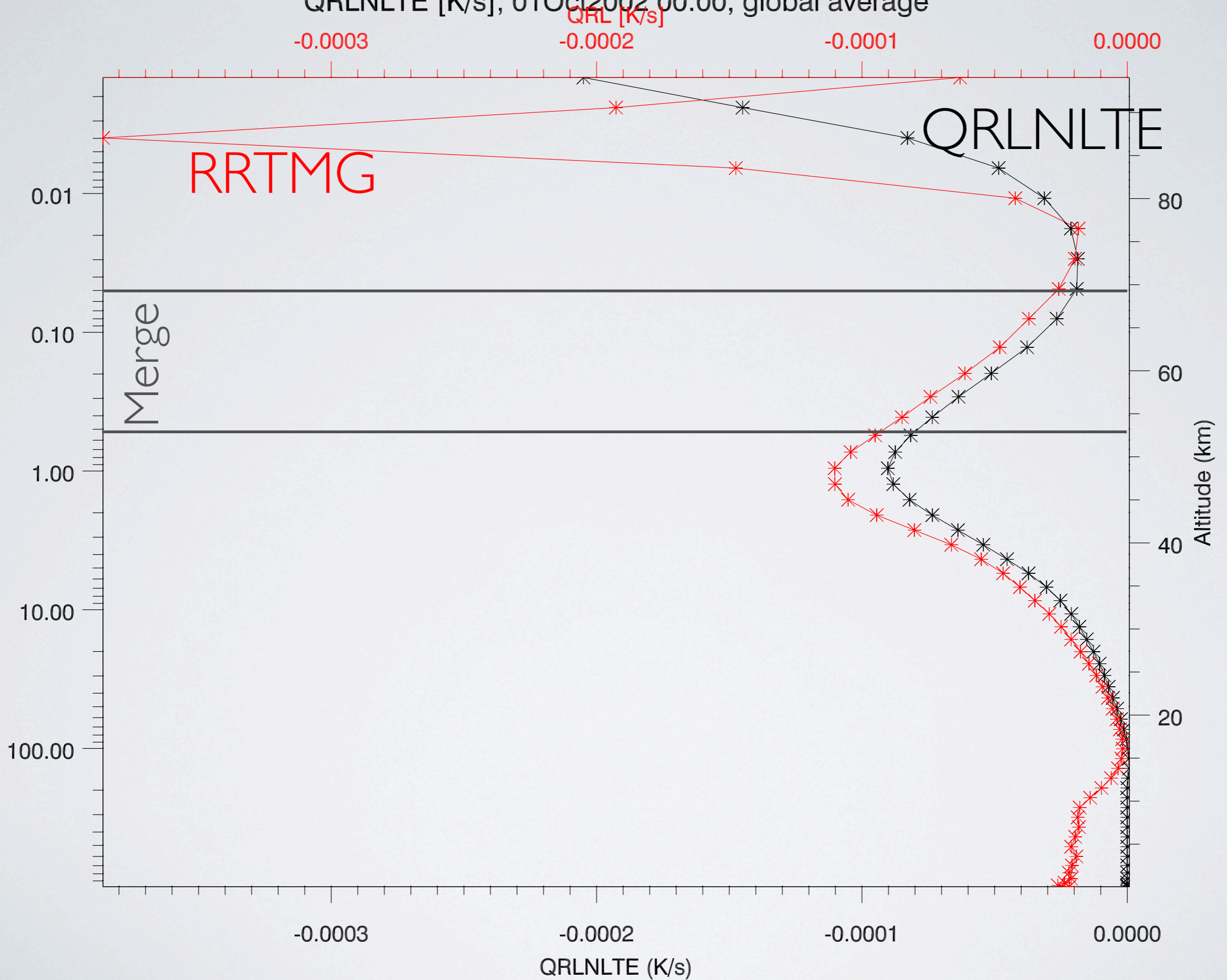
QRS\_MLT [K/s], 01Oct2002 00:00, global average

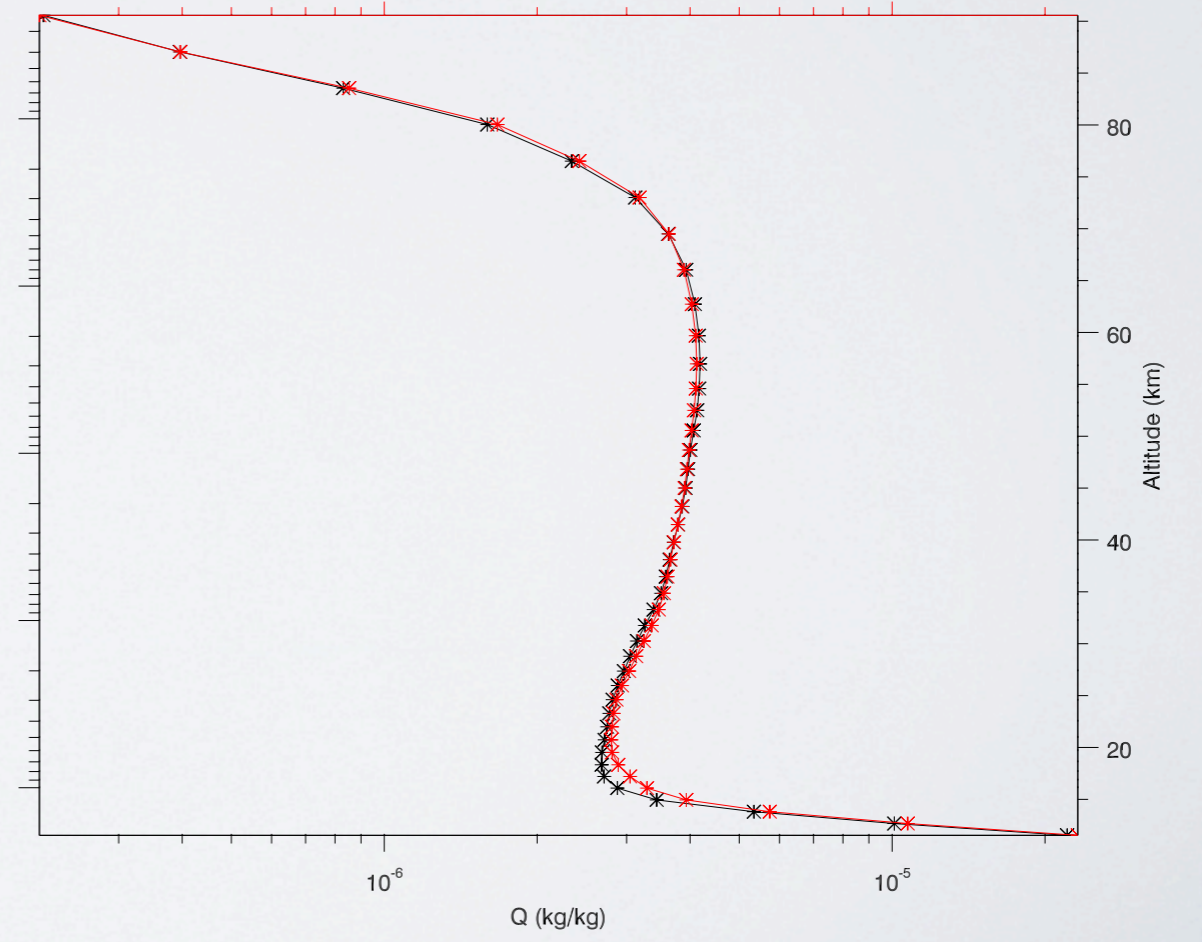
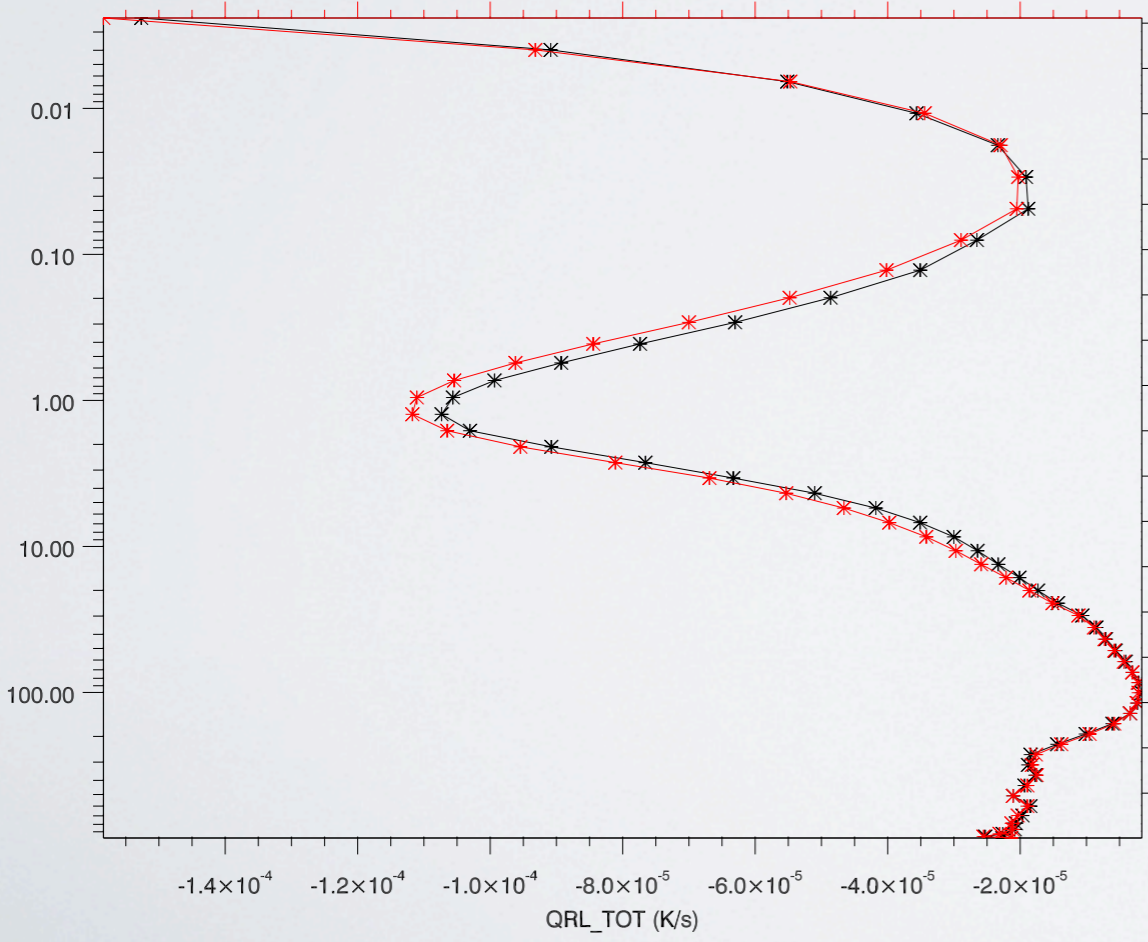
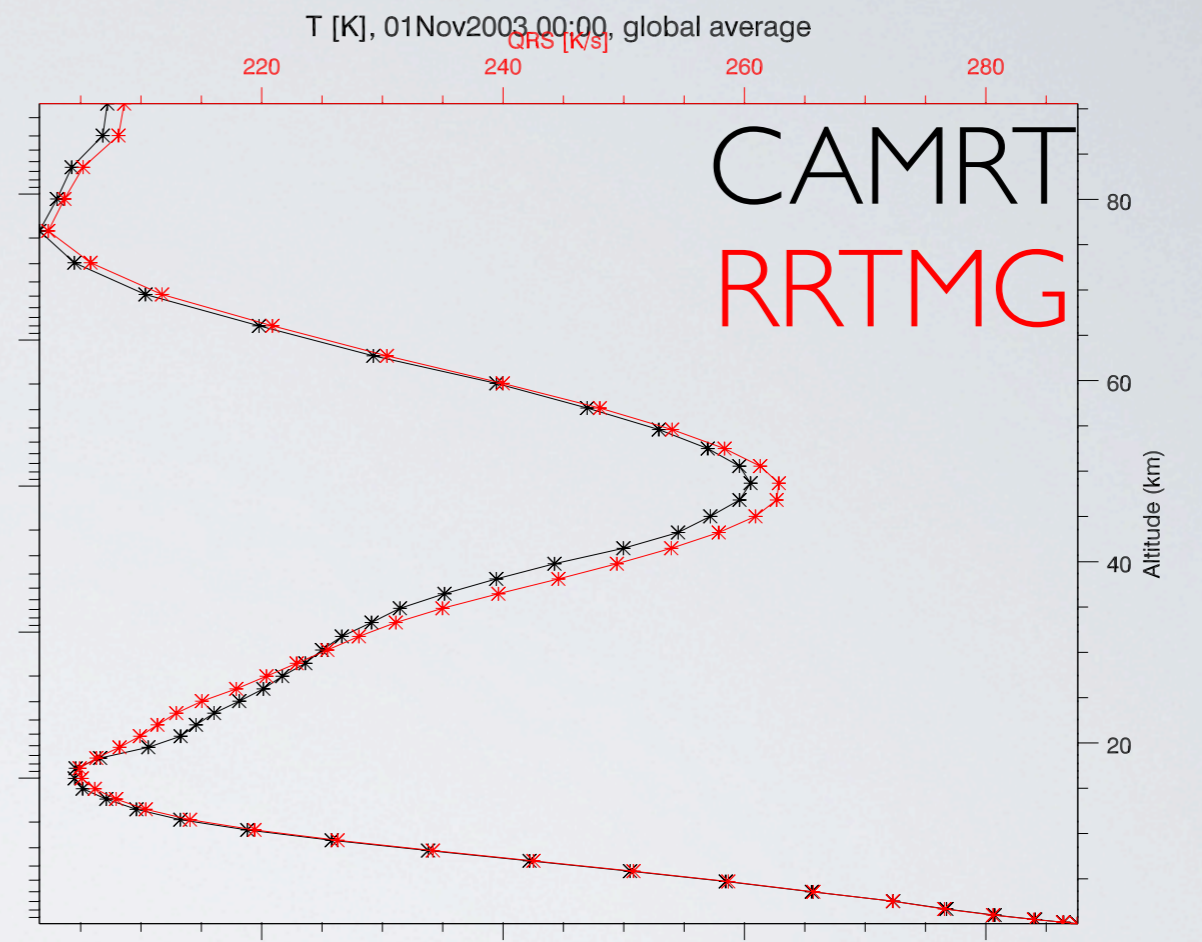
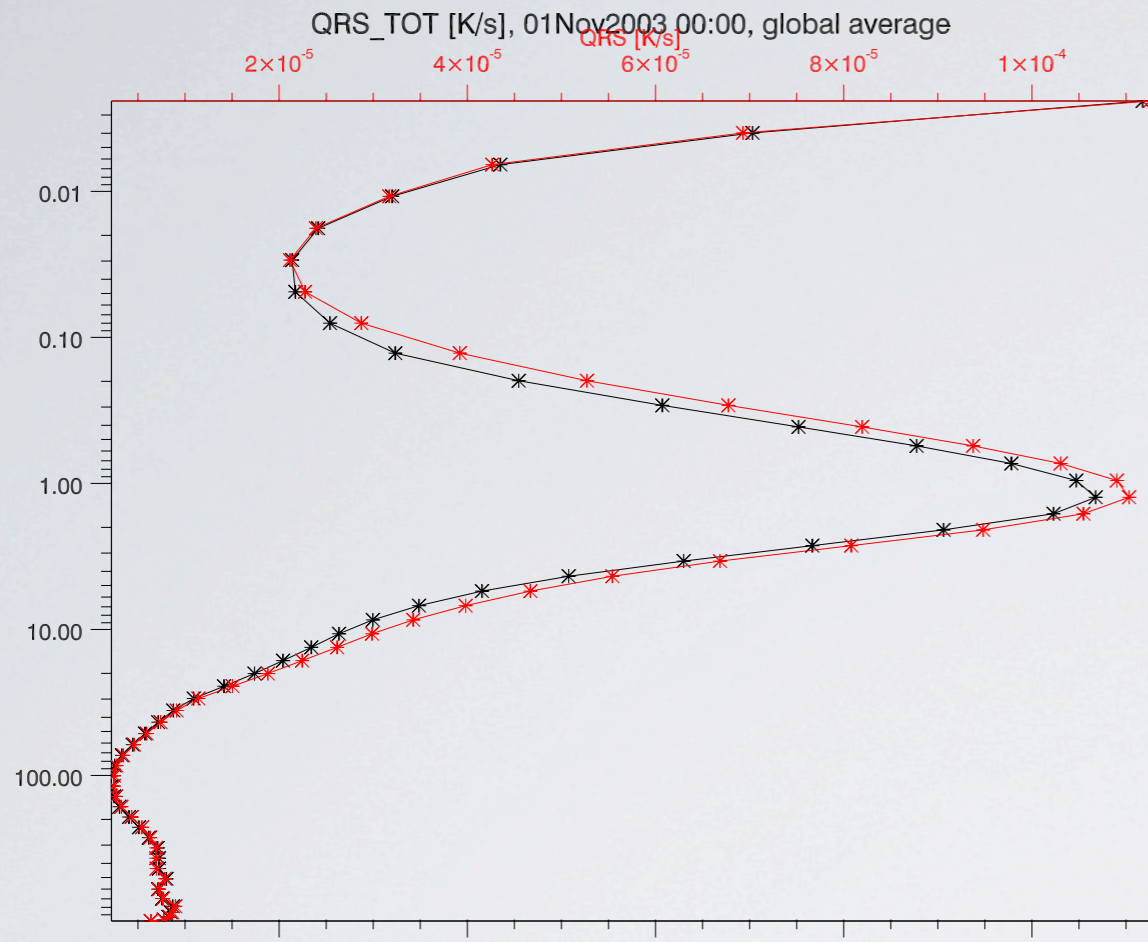


QRLNLTE [K/s], 01Oct2002 00:00, global average



QRLNLTE [K/s], 01Oct2002 00:00, global average



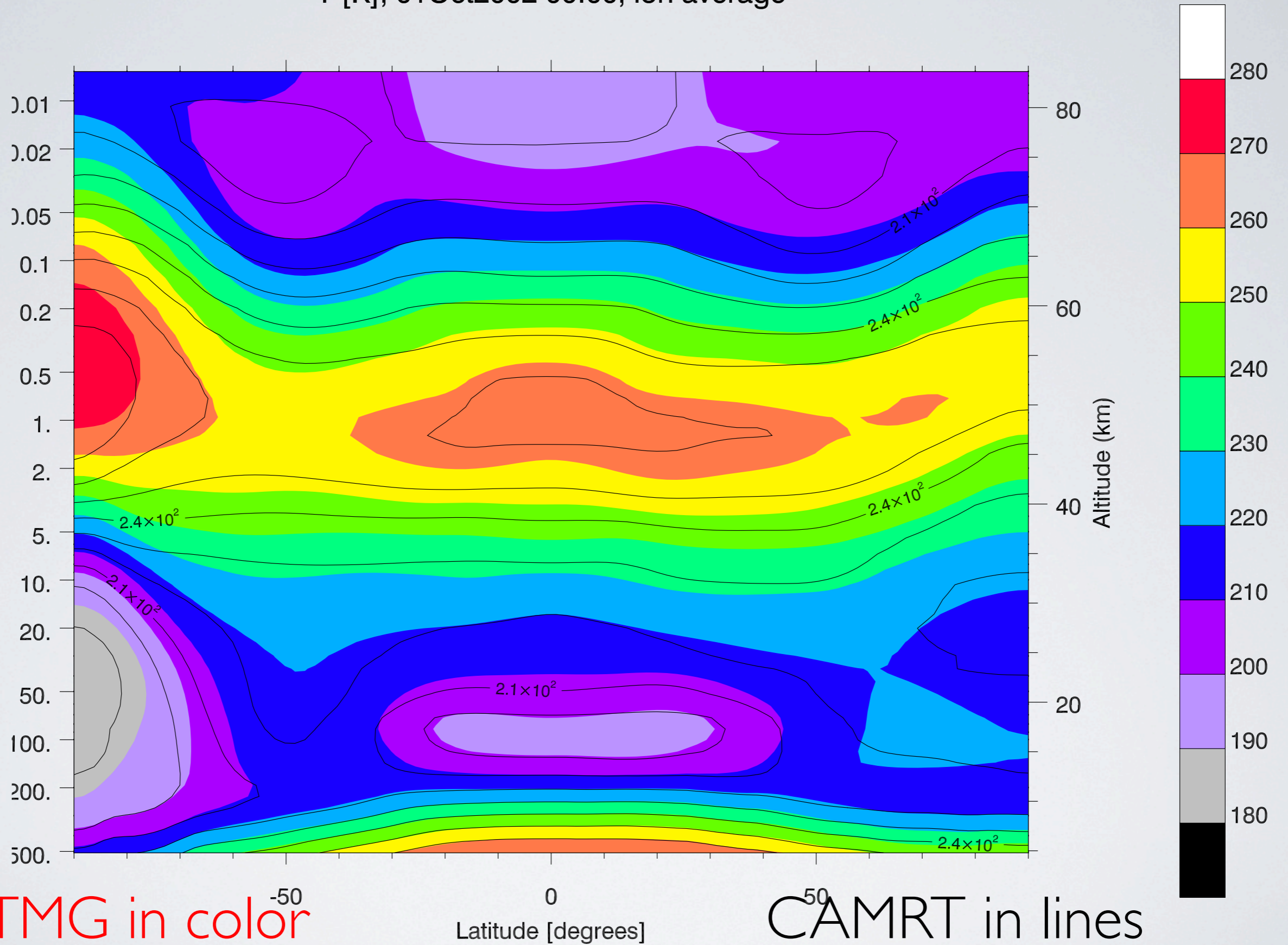


# QRL VS QRL\_NLTE (IMB)

	Kutepov GRL 2007	RRTMG
H2O	5-7%	11%
O3	25%	18%
CO2	70%	70%
Total	9.e-5 K/s	11.e-5 K/s

- QRL\_NLTE: no effects from H2O
- Removal of H2O from RRTMG reduces difference by 50%
- RRTMG for CO2, H2O needs review

T [K], 01Oct2002 00:00, lon average



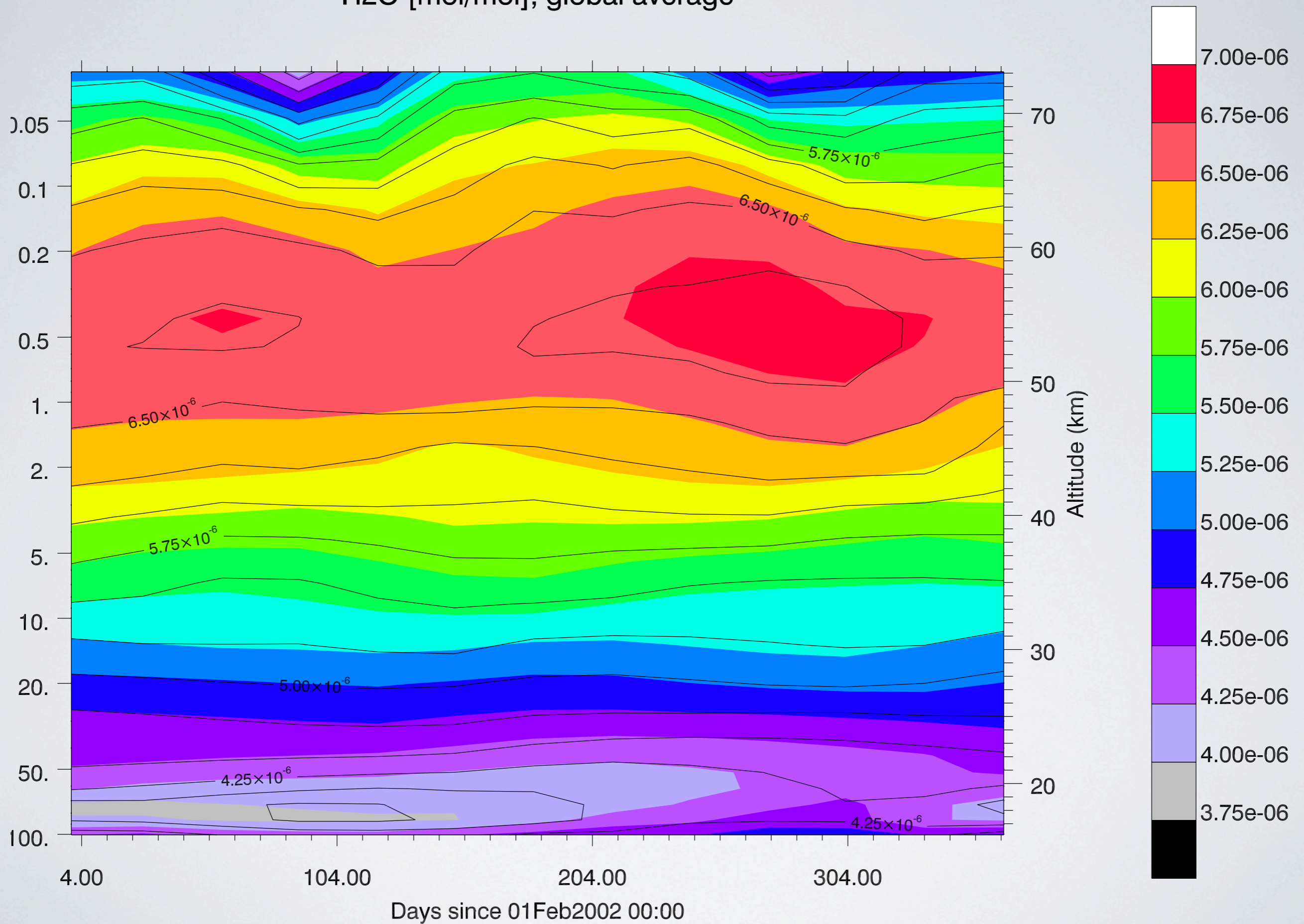
RRTMG in color

Latitude [degrees]

CAMRT in lines



# H2O [mol/mol], global average



# OPPORTUNITIES

NAT solver (source of crash)

Heating from (SAD) Volcanic Aerosols

Specification of CFC11, CFC12, CFC22, CCL4

QRL vs QRL\_NLTE Heating Rates at 1mb

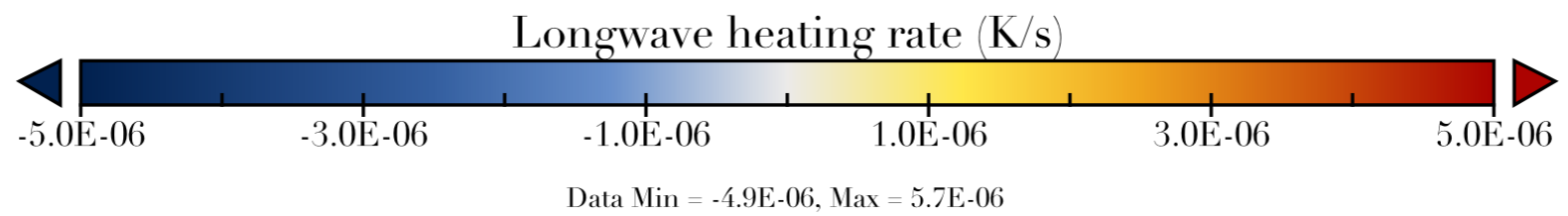
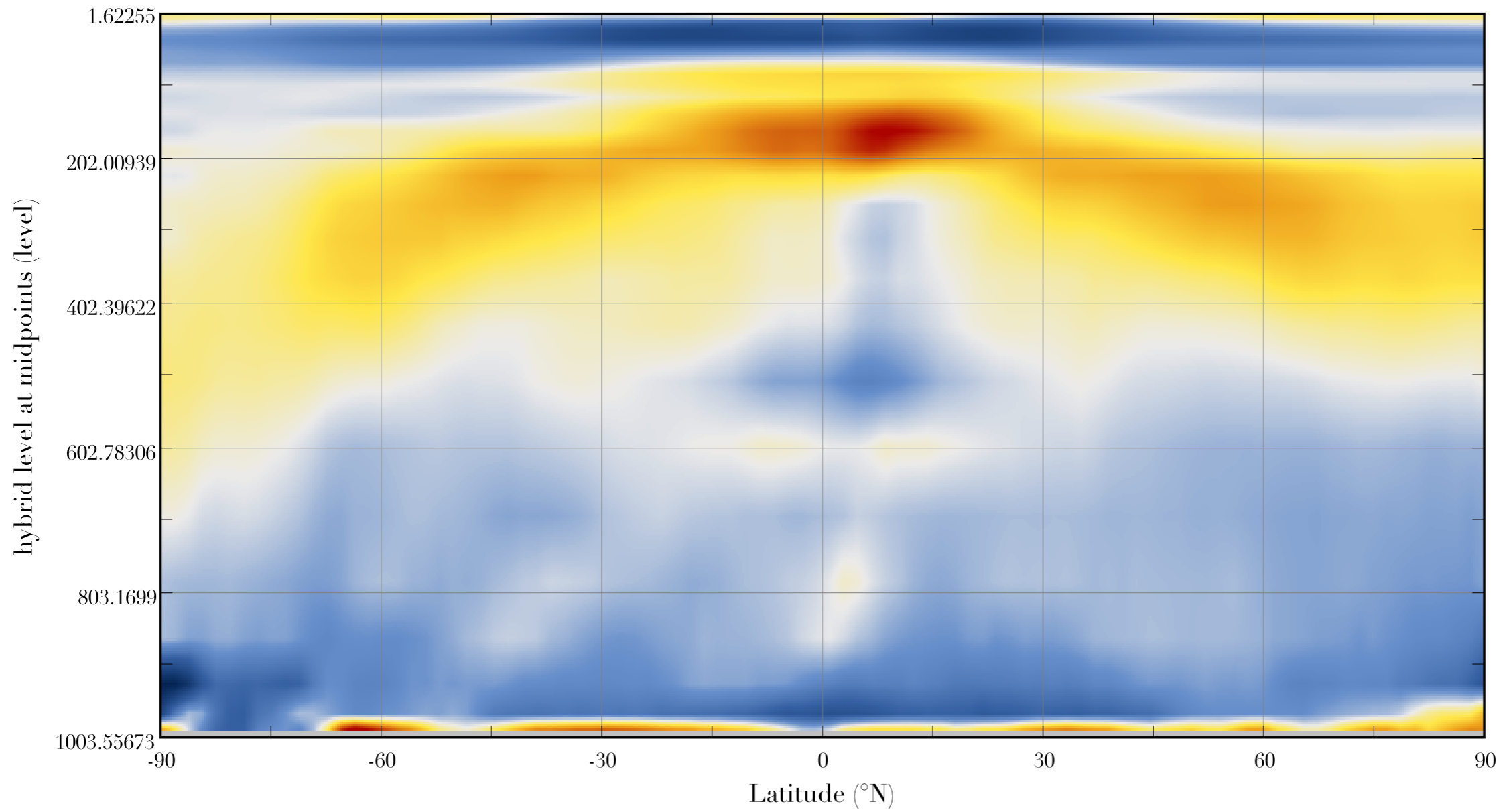


That's all, folks!

# NET LW FLUX

	Base: W/m <sup>2</sup>	RRTMG - CAMRT
Top	221	-0.60
Surface	49	-1.39
Top/Clear	261	-3.08
Surface/Clear	81	-4.25
Cloud (Top)	40	-2.49

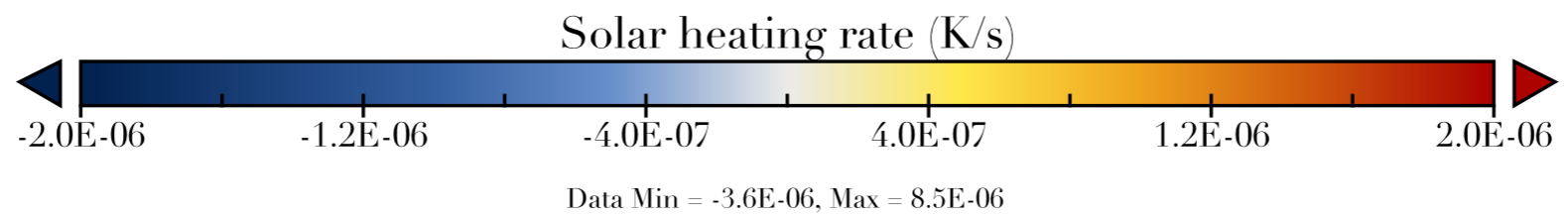
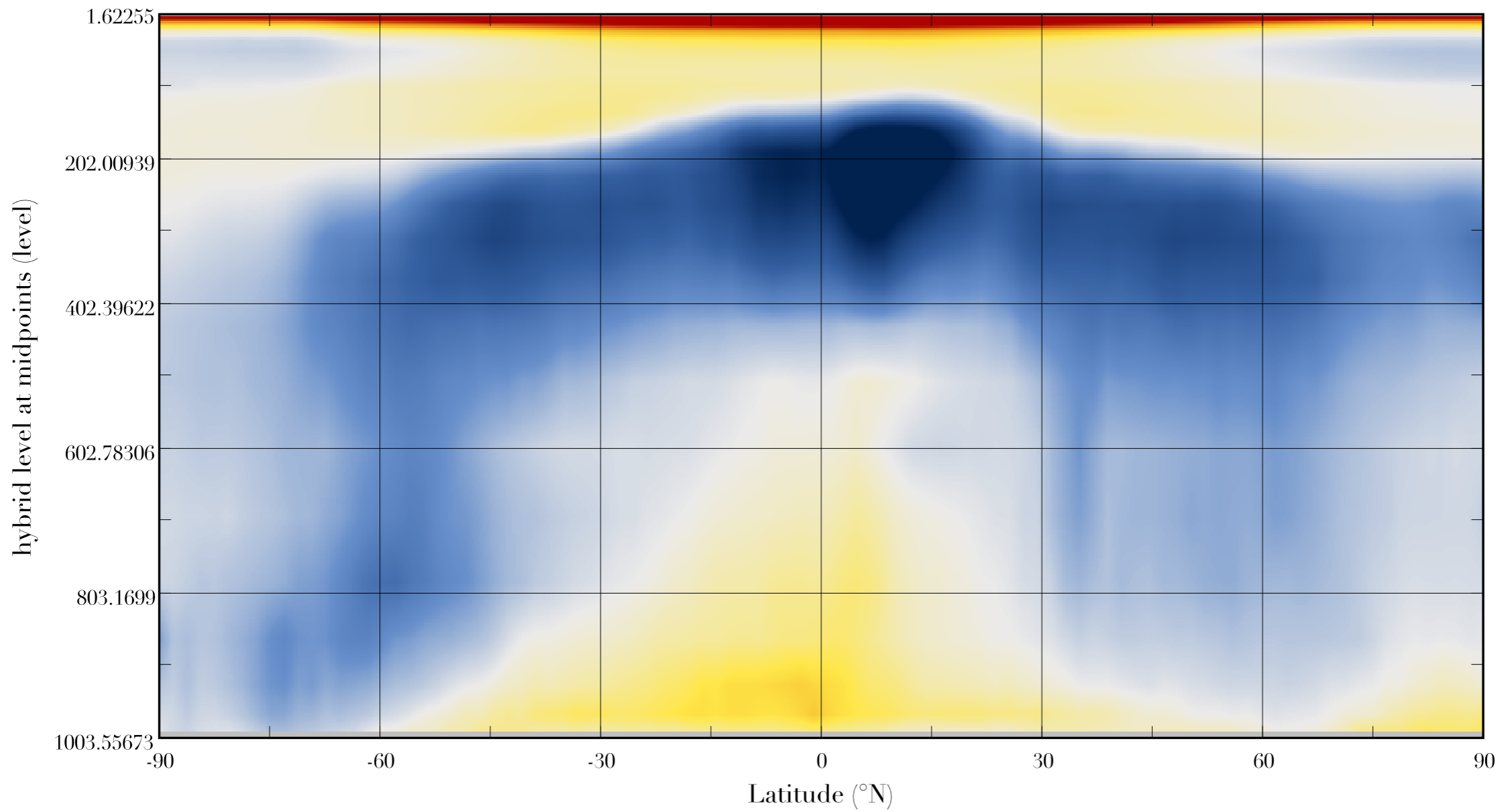
# Longwave heating rate (RRTMG - CAMRT) ( $\pm 5e-6$ shown)



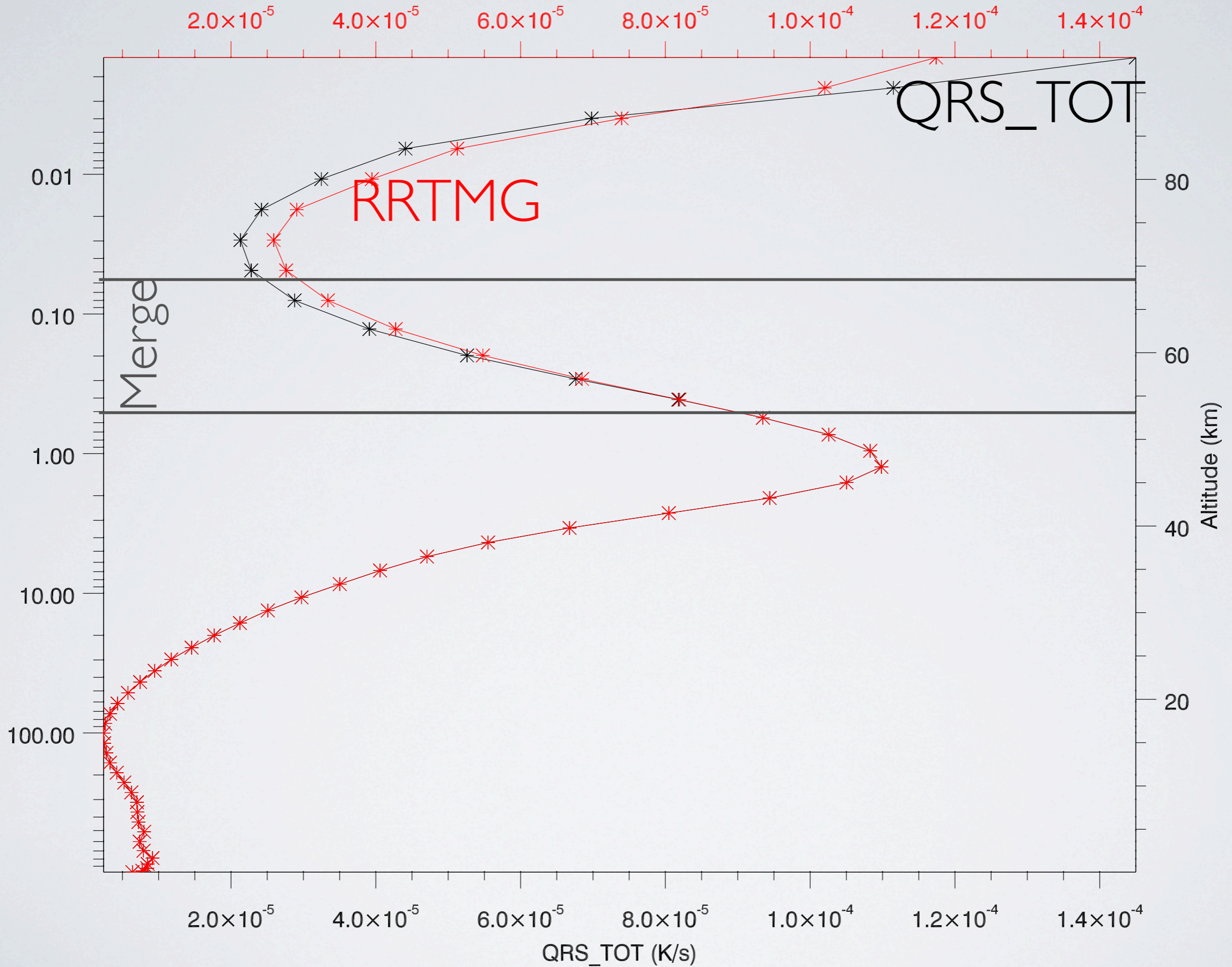
# NET SW FLUX

	Base: W/m <sup>2</sup>	RRTMG - CAMRT
Top	217	-4.33
Surface	142	-1.97
Top/Clear	288	-1.33
Surface/Clear	217	-1.47
Cloud (Top)	-71	-3.01

# Solar heating rate (RRTMG - CAMRT) ( $\pm 2e-6$ shown)



QRS\_TOT [K/s], 01Oct2002 00:00, global average



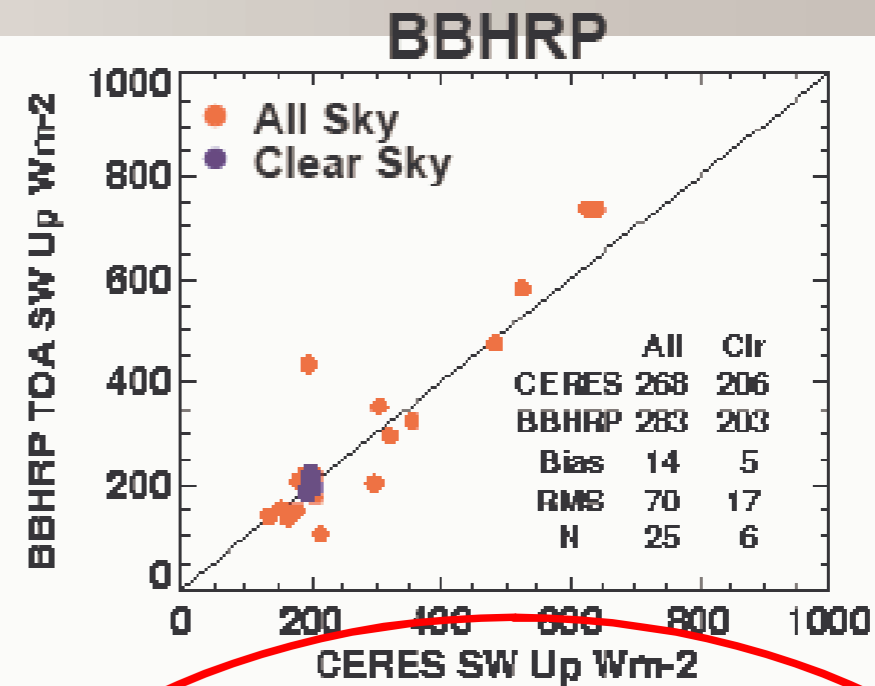
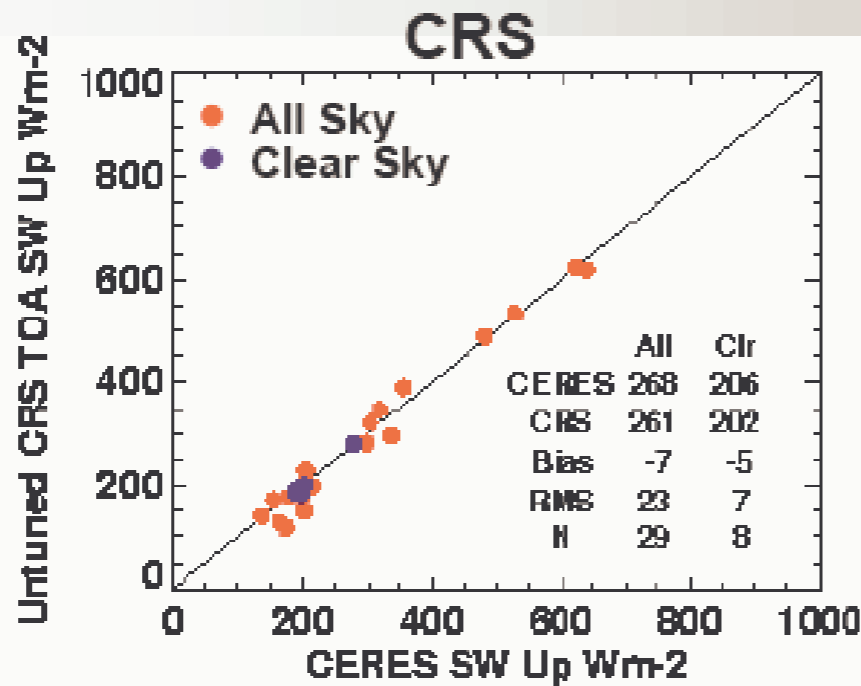


About a 1 W/m<sup>2</sup> error Relative to CERES

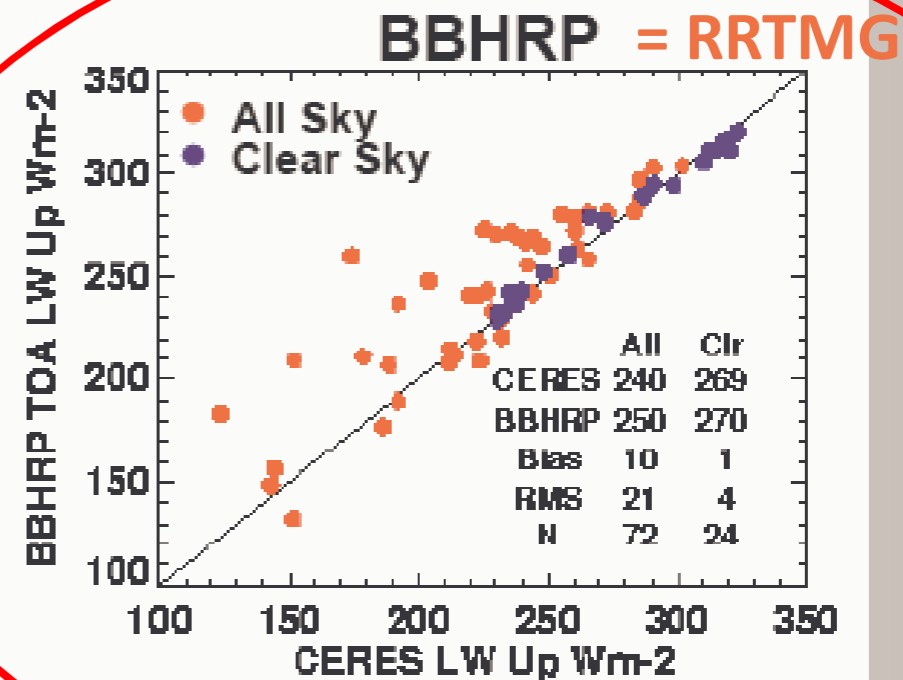
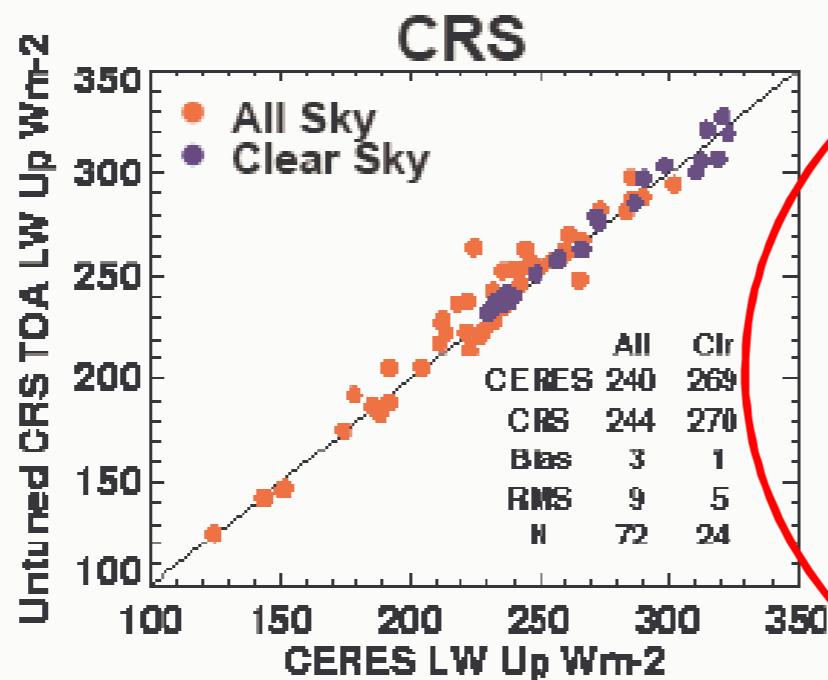


# TOA Model to Observation (CERES)

SW



LW

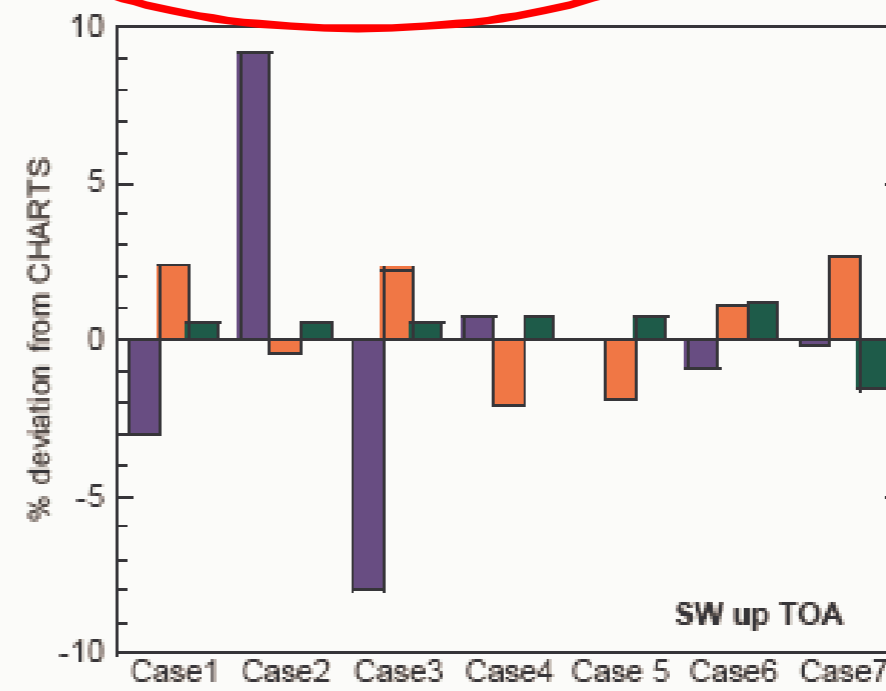
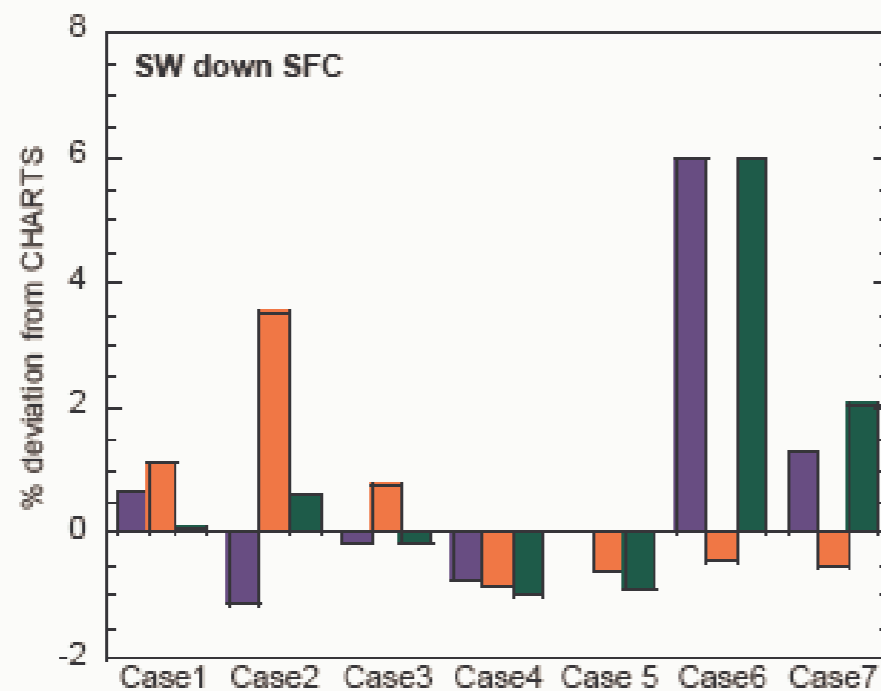
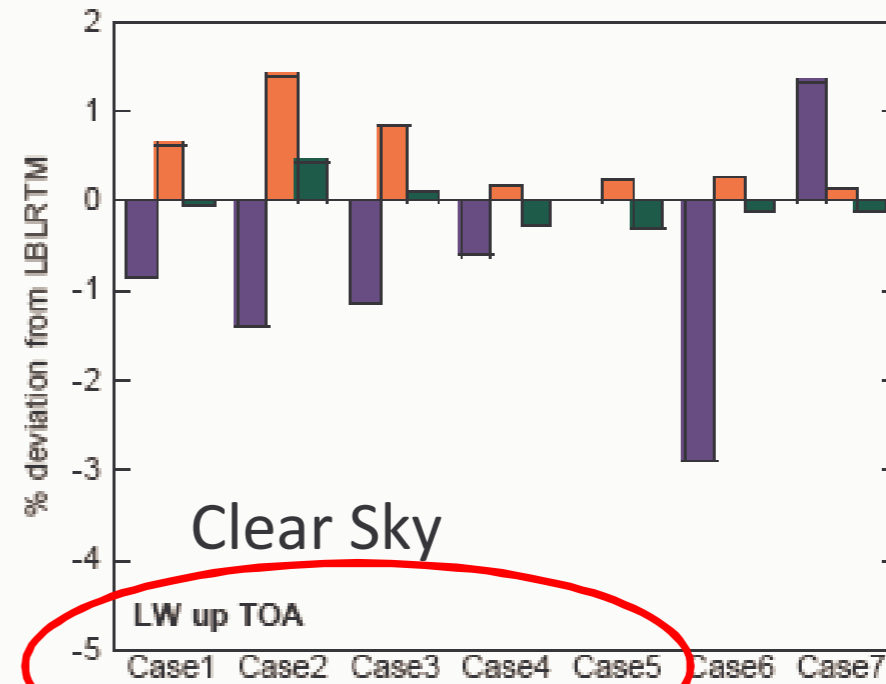
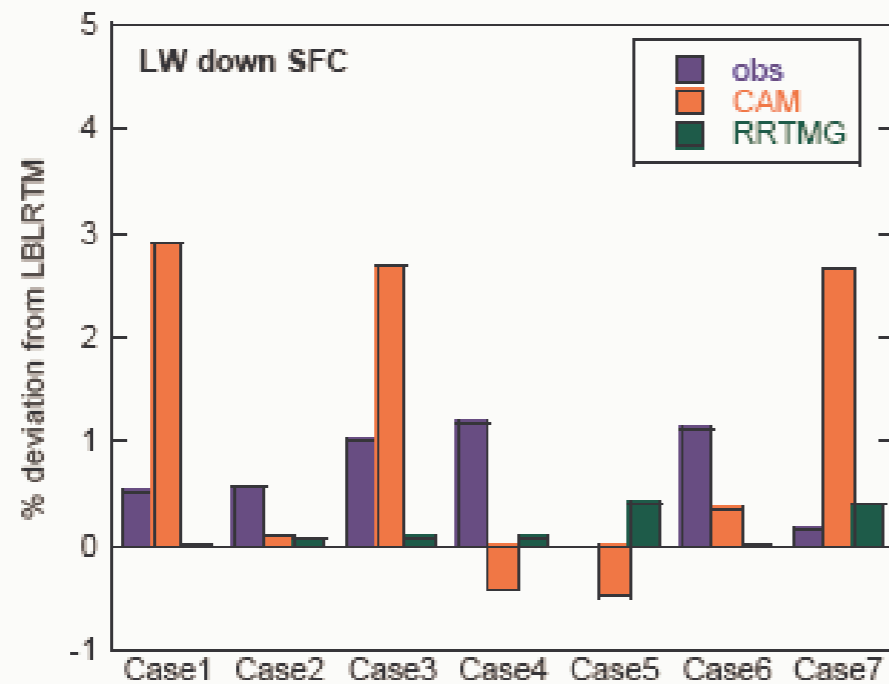


XVI ARM Science Team Meeting – Mar 27-31, 2006, Albuquerque, NM

Based on Observed Atmos/Surf State

Dave Rutan and Tom Charlock

# RRTMG vs Benchmark LBL Code



Based on Observed Atmos/Surf State

Lazaros Oreopoulos